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EVERETT, MASS.

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MONTHLY PROGRESS REPORT

ENGINEERING PROGRAM FOR THE

DEVELOPMENT OF A LIGHTWEIGHT

ANTI-TANK ROCKET

FOR THE PERIOD

MONTH OF MAY 1958

CONTRACT NO. RD-142

~~ORDNANCE PROJECT NO.~~

~~DEPT OF ARMY PROJECT NO.~~

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FLIGHTEX FABRICS, INC.

PROGRESS REPORT #9

ENGINEERING PROGRAM FOR THE DEVELOPMENT OF A LIGHTWEIGHT ANTI-TANK ROCKET

MAY 1958

CONTRACT NO. RD-142

PREPARED BY _____ APPROVED BY _____

Thomas Forman
Project Engineer

Charles B. Weeks
General Manager

SUBMITTED BY: HESSE-EASTERN DIVISION
FLIGHTEX FABRICS, INC.
EVERETT, MASSACHUSETTS

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WORK DONE DURING THE MONTH OF MAY 1958

REPORTING PERIOD 7 MAY 1958 TO 5 JUNE 1958

SYSTEM EVALUATION PROGRAM

Static penetration tests have made it possible to choose a warhead. Ignition tests have been conducted. One more test will have to be conducted in order to finalize on the motor. A final test program has been drawn up and is included in the appendix.

MOTOR DEVELOPMENT PROGRAM

Four different combinations of black powder propellant and igniter configuration were tried during the month. The following tabulation shows the results of these tests in detail. The tests had to be run at two different times, since ignition problems caused the loss of some rounds during the first test.

(The above tabulation is shown on the following page.)

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COMBINATION I

3 GRAMS BLACK POWDER

Round No.	+ 80°F	Round No.	-20°F
152	Firing pin stuck	157	380 F/S, BT .027, 6 ft. OB ☐ 70M
153	400 F/S, BT .013 ☐ 70M	155	BP not initiated
154	BP not initiated	156	BP not initiated
* 182	384 F/S, BT .021, OB ☐ 60M	* 184	280 F/S, BT .027; grazed 70 yds.; one unburned stick
* 183	385 F/S, BT .020 ☐ 60M	* 185	Primer dud; refired at ambient with new propellant
* 185	357 F/S, BT .021 ☐ 80M		

COMBINATION II

1/4" OFF STICKS 3 GRAMS

158	333 F/S, BT .034, 6 Ft. OB (INT) ☐ 80M	161	340 F/S, BT .033, 6 Ft. OB ☐ 80M
159	BP not initiated	162	340 F/S, BT .033, 6 Ft. OB ☐ 80M
160	380 F/S, BT .027, 6 Ft. OB ☐ 80M	163	340 F/S, BT .033, 6 Ft. OB ☐ 80M
* 176	357 F/S, BT .022, OB ☐ 60M		

COMBINATION III

SHIELD OVER IGNITER 5 GRAMS BLACK POWDER

+ 80°F		- 20°F	
Round No.		Round No.	
164	430 F/S, BT .018 2 Ft. OB [ ] 70M	167	BP not initiated
165	410 F/S, BT .019, 6 Ft. OB [·] 60M	168	As No. 167
166	Primer fails to function	169	As No. 167
* 178	330 F/S, BT .054, OB [·] 70M	*179	94 F/S, BT..018; grazed 70 yds.; two unburned cracked sticks
		*180	230 F/S, BT .038; grazed 90 yds.; one unburned cracked stick
		*181	79 F/S, BT .019; grazed 50 yds.; two unburned sticks

COMBINATION IV

1/4" OFF STICKS 5 GRAMS BLACK POWDER

170	416 F/S, BT .019, 2 Ft. OB [·] 70M	173	Primer fails to function
171	416 F/S, BT .021, 2 Ft. OB [·] 70M	174	357 F/S, BT .027, OB [·] 70M
172	416 F/S, BT .020, 2 Ft. OB [·] 70M	175	218 F/S, BT .017; grazed 60 yds.
		*177	278 F/S, BT .046, OB (INT) [·] 70M; long ignition delay; one unburned cracked stick

LEGEND

☐	=	10 ft X 10 ft target
OB	=	Outside launcher burning
BT	=	Burning time in seconds
F/S	=	Velocity in feet per second
*	=	Test conducted on 16 May 1958; used 25 caliber primer plus cartridge case
(INT)	=	Intermittent
BP	=	Black powder

Hesse-Eastern

EVALUATION OF TEST RESULTS

It appears that with the exception of combination 2, unsatisfactory ignition is being obtained at the low temperature with all the other combinations.

As can be seen from the results, three rounds of each combination were fired at ambient temperature and three rounds at -20°F. The burning time appears to be satisfactory in most cases, and the velocities are consistent with previous tests. However, it has to be stated that due to trouble experienced with the Fastax camera the velocity readings are not 100 per cent reliable. Outside-of-launcher burning was observed in all the cold rounds. It is expected that this problem can be overcome by decreasing the round velocity. The original motor design was based on a velocity of between 300 and 350 feet per second at both extremes of temperature. It appears that with the round weight used in these tests (approximately 1,480 grams) velocities are 30 to 40 feet per second too high. The reduction of round velocity will be obtained by additional weight. This weight addition will be necessary in order to strengthen the motor (see last month's Progress Report). Further weight can be added if desired by using a heavier ogive. An additional test of ten rounds of combination 2 will be conducted in the first few days of June in order to get further data.

PRIMER IGNITION

Ten rounds were lost in the first part of the tests reported above due to the fact that the igniter did not work. Two types of malfunctions were encountered:

A. Jamming of the firing mechanism. This was caused by the fact that the firing pin in the igniter assembly used for these tests is sliding inside a polyethelene hole. It is possible for the pin to dig into the polyethelene and thereby jam. It is also possible for the cross-piece to be cocked, thereby creating interferences. A new design is in the process of manufacture and will eliminate mechanical interferences. This is discussed in the launcher section.

B. Primer malfunctions:

Two types of primer malfunctions are possible:

1. Primer is hit by the firing pin and does not initiate.
2. Primer initiates but does not ignite the black powder.

(1) If the energy level of the firing pin is overmatched by a sufficient amount, there should always be enough energy available to initiate the primer. It is customary in rifle and pistol design to overmatch the input requirements of the primer by a factor of 3 to 1. The firing spring has an output of 49.9 inch-oz. The input requirements of the primer are 15.5 inch-oz.

(2) The majority of malfunctions with only one exception were caused by this possibility. It has to be stated that some jamming of

the firing mechanism (possibility No. 1) occurred but that the rounds could be reassembled and fired later on in the test. It appears that at the low temperature the black powder charge gets blown out of its container by the gas pressure from the primer. The black powder is found spread throughout the motor body and the propellant sticks without having ignited the propellant. It is very probable that a shock wave forms ahead of the flame, causing a sufficient build-up of pressure in the igniter bag to blow it apart before the flame itself reaches the black powder. After the test on 6 May 1958 when eleven rounds were lost in this manner, the primer was redesigned. Twenty-five caliber ammunition was used for the next test. The bullet and smokeless powder charge were removed from the ammunition, and the primer positioned in the igniter assembly by the end of the cartridge case. (See Drawing No. D-8349) It is expected that some primers will be damaged by this means of disassembly. Five hundred pieces of ammunition with the bullet and charge removed have therefore been ordered.

CONCLUSIONS

It is expected that the motor will be finalized during June. Final drawings are in the process of being prepared. It is possible that an additional lot of one hundred motors will have to be machined in order to keep the test program moving until the final extruded motors are available.

WARHEAD DEVELOPMENT PROGRAM

The single angle liners have been tested, and the results are shown on the following page.

EVALUATION OF RESULTS

Whilst the relatively small number of static test rounds does not justify a very conclusive interpretation, the following may be stated; Penetration obtained with the double angle cone is by far the best obtained to date with a maximum average of 10.1/2" obtained when firing five heads statically. As can be seen from the tabulation, the mean penetration of the single angle liner is only 8". However, the variations encountered with the single angle liner are considerably smaller. The head metal parts used in this test were considerably improved in concentricities as compared to the previous test with single angle liners. However, eccentricities still range from .004 to .009. When comparing the results with the single angle liners tested in the previous month, (see page 14, April Progress Report) a considerable improvement will be observed. This is due to the selection of better (more concentric) head body assemblies. If drawn head bodies are used, much greater concentricities will be obtained, and the single angle liners will therefore produce better results. However, the time and fund situation on the project does not warrant any further testing of single angle liners. The double angle liner will more

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RESULTS OF PENETRATION

TEST: 28 MAY 1958

SINGLE ANGLE LINER 3/4 BOOSTERS

Head No.	Body	Cone to Body	Density	Penetration (in)	Remarks
1	.009	.008	1.68	-----	Low order; bad blasting cap
2	.004	.007	1.65	9"	Oval hole; third plate split
3	.006	.008	1.68	9"	Oval hole; second plate split
5	.008	.0011	1.66	8 1/4"	
8	.004	.006	1.67	8"	
12	.007	.008	1.66	9"	
14	.008	.005	1.658	6 1/4"	Elongated hole; second block split open
16	.005	.005	1.66	8"	
20	.004	.005	1.67	6 1/2"	As No. 14
21	.006	.005	1.67	8"	

Greatest penetration, 9".

Within the eccentricities recorded, no correlation between eccentricity and penetration.

Mean penetration = 8" - 20% = 6.4" in armor.

Mean excluding 14 and 20, 8.45" - 20% = 6.75" in armor.

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than fulfill the contractual requirements, and a program with single angle liners may be suggested in the final report. The final head body drawings are in the process of being prepared, and a subcontract with Eastern Tool & Manufacturing Company will be submitted for the approval of the Contracting Officer. It is of extreme importance that work on the tooling for the drawn head bodies and on the production of the double angle liners for the final quantity start as soon as possible in order to eliminate any possibility of a waiting time for head parts.

Since the spun HEAT heads had to be used for static testing, it was impossible to conduct a dynamic penetration test. It was decided to wait for the drawn heads before conducting such a test. In order to get more data on the functioning of the fully loaded round, the graze part of the series of fuze tests will have to be changed to functioning on target and determining crush-up of the ogive and functioning time.

FUZE DEVELOPMENT PROGRAM

The fuzes needed for next month's fuze test are in the process of being assembled and statically tested. No further work was done on the locking mechanism mentioned in last month's report.

LAUNCHER DEVELOPMENT PROGRAM

The new cross-piece has been laid out and details drawn. See

enclosed Drawing No. D-8349. The new design will use brass inserts for both the firing pin and the cross pin to slide in. In addition, the firing pin is obstructed to a greater extent by the cross pin than before. This is made possible by milling a slot in the cross pin which clears the spherical anvil on the firing pin. Line-up of the parts is obtained by drilling the hole for the safety pin in a jig simulating the assembly. A key in the cross member, a keyway, and a tru-arc ring in the igniter body are used to position the cross member and cross pin. A new method of locking the handle in a vertical position has been used successfully (see Photograph Nos. 84,85). As can be seen, this provides a positive stop for the handle and eliminates the possibility of the handle twisting in relation to the body of the launcher. One complete weapons system as mentioned in last month's Progress Report was turned over to Bob.

FINAL TESTING PROGRAM

The final test program has been drawn up and is shown in the appendix. This program is the result of a meeting with Bob and Andy. Comments and suggestions on this are invited.

Thomas H Fu
Project Engineer

Evaluated vs. costs expended for the month

$8,664.31

Charles B Walker
General Manager

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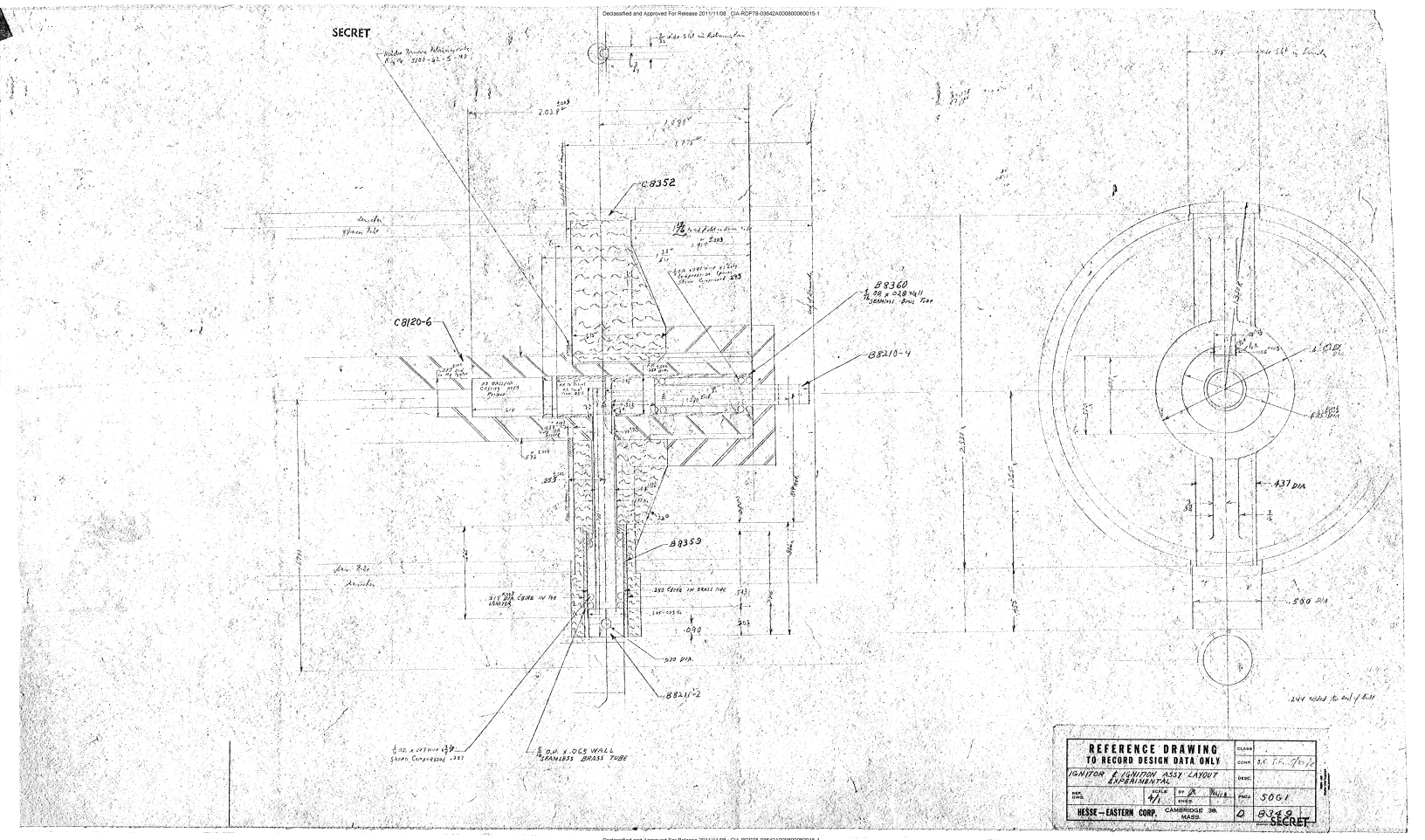

REFERENCE DRAWING TO RECORD DESIGN DATA ONLY	CLASS	
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REF. DWG.	SCALE 4/1	BY R. Hall & ENGR.
HESSE — EASTERN CORP. CAMBRIDGE 38, MASS.	PROJ.	5061
	D	9349

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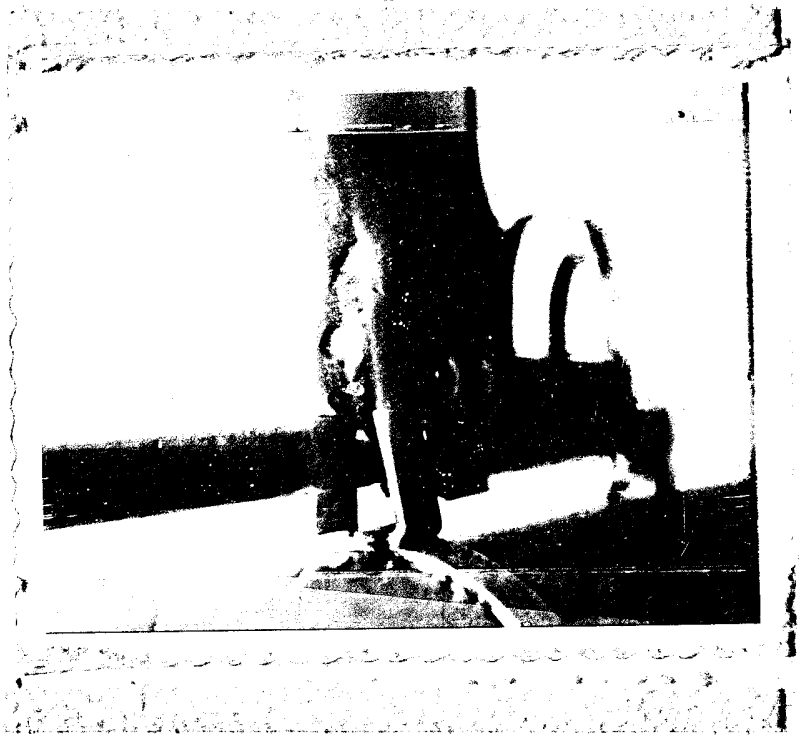
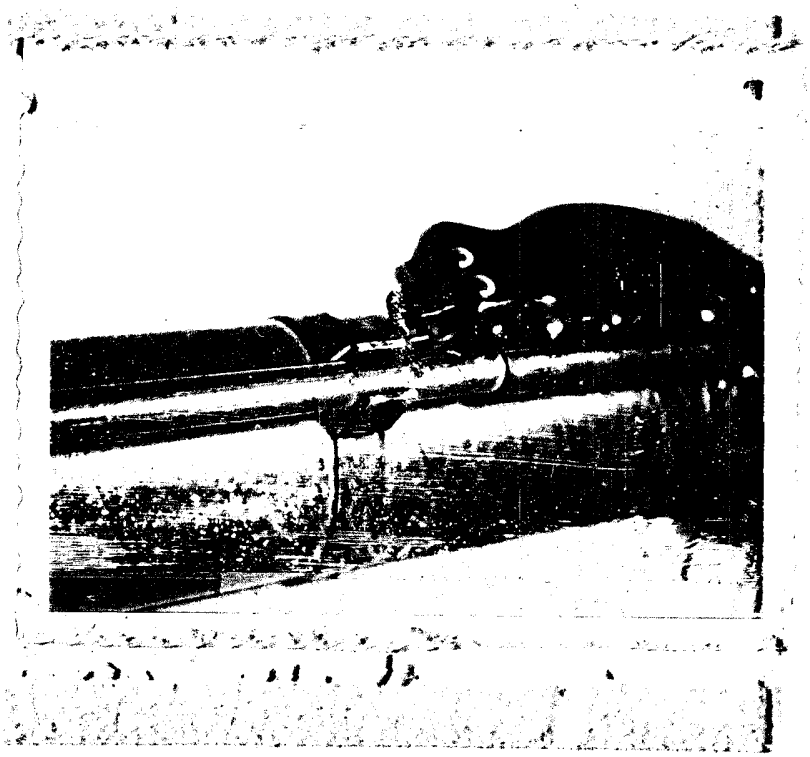
PHOTOGRAPHS



Photograph No. 84



Photograph No. 85

FINAL TEST PROGRAM

Items To Be Tested - 175 Rockets, 125 launchers, 20 Packings

Complete weapon systems with or without package as indicated in the program will be tested. All test systems will contain final heat heads and fuzes. A reasonable number of the test systems will be shoulder fired after being subjected to various transportation, handling and environmental conditions.

PART I - Control Systems - 10 Systems

Ten complete weapon systems will be fired from a test stand at ambient temperature using an armor plate target at 75 yards. The results will be carefully noted and used as a standard of comparison for systems fired under different conditions. Number of systems to be used - 10.

PART II - Delivery Tests - 20 Systems, 20 Packings

This part of the test program will check the effect of rough handling, vibration and shock on the systems in transit to user. Twenty systems packed in their individual cases will be used for this purpose.

Five systems subjected to vibration tests (MIL STD) tested at Fort Belvoir or at Hesse-Eastern if equipment is available.

Fifteen systems will be used for drop tests. The drop tests will fall in two categories:

A. A forty-foot drop which will check the condition of the system after a heavy impact. The five systems will be used in five orientations. Five systems will be held in a fixture when dropped so that no direct contact is made between the weapon system and the concrete base of the drop tower.

The remaining fifteen systems will be dropped in the orientations which the first part of the test have shown to be the worst ones. The systems will be held in such a way that they will make contact with the base of the drop fixture to check the effect of accidental dropping from a truck, etc., in combat.

The packages will be opened after the tests. The launcher and rocket will be examined and fired if the examination shows no evidence of damage. If the system has been damaged, it will be disposed of per Mil Specifications. The number of systems that malfunction under these conditions will be noted.

PART III - Individual Round Use and Environment Test - 45 Systems - No Containers

This series of tests is going to consist of:

1. Five systems fired after being subjected to a swamp and marsh test. The severity of the test will be increased from one system to the next.

2. Fifteen systems will be tested for humidity and water penetration. Extent of the exposure will be increased gradually, and the effect on the weapons functioning and effectiveness will be noted.

3. Twenty-five systems will be subjected to cold conditions. The temperature will be -25°.

PART IV - Final Dynamic Penetration Test - 100 Rockets, 50 Launchers

One hundred rockets and approximately 50 launchers will be used for this test. A reasonable number of rounds will be shoulder fired at armor plate steel targets. Rounds missing the target will be used to evaluate the graze sensitivity of the round. Launchers will be re-used to the extent indicated by the number of launchers and rockets in order to conserve funds.

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